Dioxin and PCB Contamination in Mossville, Louisiana:

A Review of the Exposure Investigation by ATSDR

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23 February 2000

Summary

The information collected by the Agency for Toxic Substances and Disease Registry (ATSDR) during the Exposure Investigation (EI) in Mossville, Louisiana supports the following conclusions:

- The blood of twenty-eight Mossville residents carries an average concentration of dioxins (including four of the dioxin-like PCBs) that is more than three times higher than the average concentration of the `background' level represented by ATSDR's comparison group.
- The relative concentrations of the 17 most toxic dioxins in the blood of the Mossville people are substantially different from those of ATSDR's comparison group. This suggests that one or more local dioxin sources are contributing to the elevated dioxin levels among Mossville residents.[1]
- The Mossville residents carry four dioxin-like PCB congeners in their blood at an average total concentration 2.8 times higher than the average levels found in the comparison group.
- Just as with the dioxins, the unique PCB profile seen in the Mossville residents suggests that there is a local source (or sources) of PCBs.
- Dioxins and PCBs in the Mossville environment may have different sources since total dioxin concentrations and total PCB concentrations in the blood of Mossville residents are independent, e.g., a person with high dioxin concentrations may have low PCB levels in his/her blood while a person with low dioxin levels may have high PCB levels.
- The failure to find among any of the 28 Mossville residents a detectable level of the PCB congener that is the congener present at the highest concentration in the comparison group suggests potential problems in the analysis of the Mossville samples and/or the comparison group. As a consequence, the Mossville samples should be reanalyzed and the sampling and analysis protocols followed with both groups of samples should be examined.
- The breast milk of one nursing mother from Mossville was analyzed and found to carry a total concentration of dioxins and four dioxin-like PCBs that is 30 percent higher than the average level found in U.S. breast milk during 1995-97. This finding suggests that infants born in Mossville may be experiencing higher prenatal and postnatal dioxin exposure than the average U.S. infant.
- Two eggs from chickens raised by Mossville residents carried dioxin levels that were 10-14 times higher than those of home-produced eggs from an uncontaminated area of California. Dioxin levels in the Mossville eggs were two times higher than the level at which the Food and Drug Administration (FDA) classifies eggs as adulterated.[2]
- Dioxin levels in soil samples from the yards of three Mossville homes were, on the average, a factor of 17 times higher than the level in rural soils and 1.5 times that in urban soils from the U.S. and Canada,[3] or about twice the average level for U.S. soils.[4] A very low dioxin concentration was found in a soil sample taken from a chicken coop where the owner reported having *"placed clean sand over the dirt floor of the coop."*
- Since neither the soils nor the eggs from Mossville were analyzed for PCBs and other dioxin-like chemicals, such analyses must be carried out if a more complete assessment of the exposure of Mossville residents is to be done. For example, such data are required to determine whether dioxins and dioxin-like contaminants in Mossville soils exceed ATSDR's Action Level of 1 ppb or its EMEG of 50 ppt.

Introduction

On November 19, 1999, the Agency for Toxic Substances and Disease Control (ATSDR) released the final report of the investigation of dioxin contamination in Mossville, Louisiana, a community that is *"located across the road from a large vinyl chloride monomer (VCM) plant."* [a] The purpose of this Exposure Investigation (EI) was *"to determine if there was evidence for increased exposure to dioxins in residents of Mossville"*.

As presented in the summary and discussed in greater detail in this report, some of the primary conclusions presented in ATSDR's final EI report appear to be well based. However, certain conclusions and observations are not supported by the data generated during the EI or are based on comparisons with invalid or outdated information.

The primary conclusions drawn by ATSDR are as follows:

(1) Blood dioxin levels were elevated in residents of Mossville who participated in the EI. The median and mean concentrations of dioxin TEQs in the EI participants were greater than the 95th percentile concentration of a comparison population.

(2) The blood levels of many, but not all, of the individual dioxin-like compounds were elevated in the EI participants. The levels of 1,2,3,7,8-pentachlorodibenzo-p-dioxin were particularly elevated and were the most significant contributor to the dioxin TEQ total.

(3) Blood dioxin levels were primarily elevated in older residents of Mossville ($\geq$ 47 years old).

(4) The blood dioxin concentrations measured in the EI participants are unlikely to be associated with known clinical health effects such as chloracne or elevated liver enzyme levels.

(5) Dioxin TEQ concentrations in four surface soil samples and two chicken eggs were not at levels of health concern.

(6) *The concentration of dioxin TEQs in a breast milk sample was not elevated.*

(7) *The source of the increased dioxin exposure in residents of Mossville is not known.*

In addition, ATSDR presented the following findings and observations in the text of their report and, as noted, in their responses to comments on their preliminary report of the Exposure Investigation:

"The levels of dioxin contamination detected in surface soil from three Mossville yards were 36 to 250 times less than the ATSDR Action Level [1 ppb I-TEQ] and do not pose a health hazard."

"The levels of dioxin detected in the Mossville egg samples do not pose a health hazard."

"The finding that egg and soil dioxin levels were not elevated does not exclude the possibility that exposures are occurring through other pathways or food sources."[5]

[a] Except where otherwise noted, all italicized quotations in this report are direct excerpts from the report -- U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, 1999. Health Consultation (Exposure Investigation): Calcasieu Estuary (a/k/a Mossville), Lake Charles, Calcasieu Parish, Louisiana, CERCLIS No. LA002368173, November 19, 1999

On the important issue of whether the elevated dioxin levels of Mossville residents are the result of current or past exposures, ATSDR offered two conflicting opinions:

" … the elevated blood dioxin levels in the EI participants could be the result of exposures that occurred many years ago."

"Current body burdens of dioxin [in Mossville residents] are likely the result of past as well as current exposures."[6]

Discussions of the data gathered by ATSDR and the ways in which these data do and do not support the conclusions drawn by ATSDR are presented in the following sections of this report.

Dioxins and PCBs in the Blood of Mossville Residents

ATSDR measured the concentrations of dioxins and four dioxin-like PCBs in the lipid fraction of the blood of 28 individuals ranging in age from 20 to 83 years of age.[b] Among the Mossville residents, the average concentration of these contaminants, expressed as toxic equivalents (W-TEQ)[c], was 3.25 times higher than the average background level as represented by ATSDR's comparison group. In 1998, a comprehensive review of scientific studies persuaded WHO experts that *"subtle effects might already be occurring in the general population in developed countries at current background levels of exposure to dioxins and dioxin-like compounds*."[7]

In the Mossville blood samples, the concentrations of dioxins and PCBs, expressed as W-TEQ, ranged from 3.8 to 186 parts per trillion (ppt). ATSDR ATSDR further described the data as follows:

"…The median (54.8 ppt) and mean (68.3 ppt) … in the EI participants exceeded the 95th percentile concentration (37.5 ppt) of the comparison population."

"Blood dioxin levels in the EI participants also increased with age, but the age-related increase was greater in the EI participants than in the comparison population."

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[b] Excluded from the study were people who had lived within the specified area in Mossville for less than five years, those under 18 years of age (preference was given to older people), and those who were pregnant, had a blood clotting disorder or other medical condition that precluded them from donating a 70-ml blood sample.

[c] To calculate toxic equivalents (TEQ), the concentration of each 2,3,7,8-substituted chlorinated dibenzo-p-dioxin and dibenzofuran and other dioxin-like chemical is multiplied by the specific Toxic Equivalency Factor (TEF) that it has been assigned and the resulting values are summed, yielding the total TEQ. Prior to 1998, the TEFs most commonly used were those established by NATO, and the results from their use are commonly denoted as I-TEQs. In 1998, World Health Organization (WHO) assigned new TEFs, with total TEQs commonly denoted as WHO-TEQs or W-TEQs. The I-TEFs are presented in the following report: North Atlantic Treaty Organization. Pilot study on international information exchange on dioxins and related compounds, scientific basis for the development of the international toxicity equivalency factor (I-TEF) method of risk assessment for complex mixtures of dioxins and related compounds. Report no. 178, 1988. WHO TEFs are presented in the following study: Van den Berg M, Birnbaum L, Bosveld ATC, Brunström B, Cook P, Feeley M, Giesy JP, Hanberg A, Hasegawa R, Kennedy SW, et al. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. Environ Health Perspect 106:775-792 (1998). TEQs based on WHO TEFs are commonly denoted as W-TEQs.

"… the profile of dioxin-like compounds in the EI participants was distinctly different from the comparison population. " This was further elaborated as follows:

"The blood serum levels of 1,2,3,7,8-pentachlorodibenzo-p-dioxin (PeCDD) in the Mossville residents were particularly elevated. The mean concentration of PeCDD in the EI participants (28.8 ppt) was more than 3-fold higher than the 95th percentile concentration (9.1 ppt) of the comparison population."

"The mean concentrations of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and the hexachlorodibenzo-p-dioxin congeners in the EI participants also exceeded the 95th percentile concentrations of the comparison population."

ATSDR made no comment on the PCBs found in the blood of Mossville residents. However, as with the dioxins, the `profile' of the four PCB congeners quantified in the blood of Mossville residents is distinctly different from that of ATSDR's comparison group. The concentration of the most potent of the four congeners, 3,3',4,4',5-PCB, was almost three times higher among Mossville residents, and the second most potent congener, 3,3',4,4',5,5'-PCB, was almost two times higher.

One particularly remarkable feature is the absence among the Mossville residents of 3,3',4,4'-PCB, the congener that is present at the highest level in ATSDR's comparison group. This unexplained finding is sufficiently striking that it warrants reanalysis of the Mossville blood samples and re-examination of the sampling and analytical protocols followed for both the Mossville blood samples and those of the comparison group.

Figure 1: Concentrations of Total Dioxins and Dioxin-Like PCBs in the Blood of 28 Individuals and the ATSDR Comparison Group

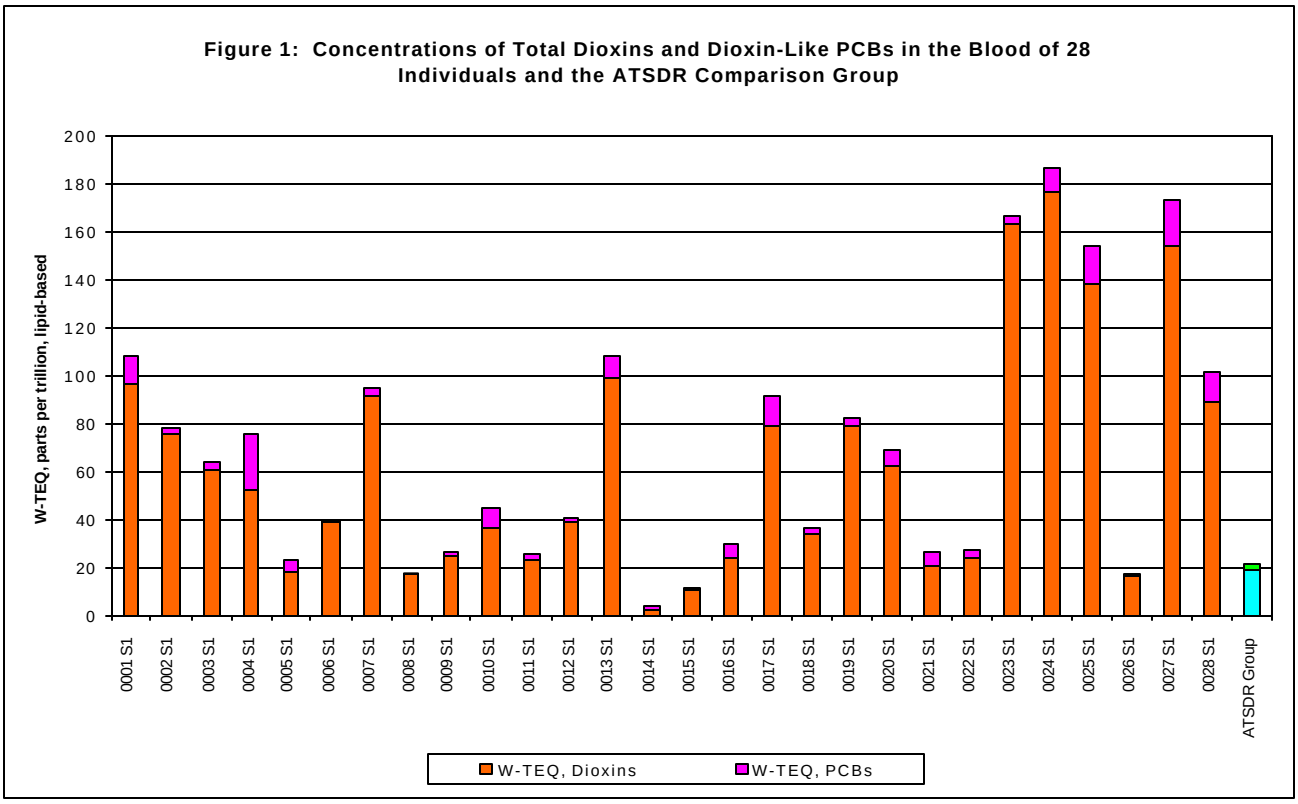
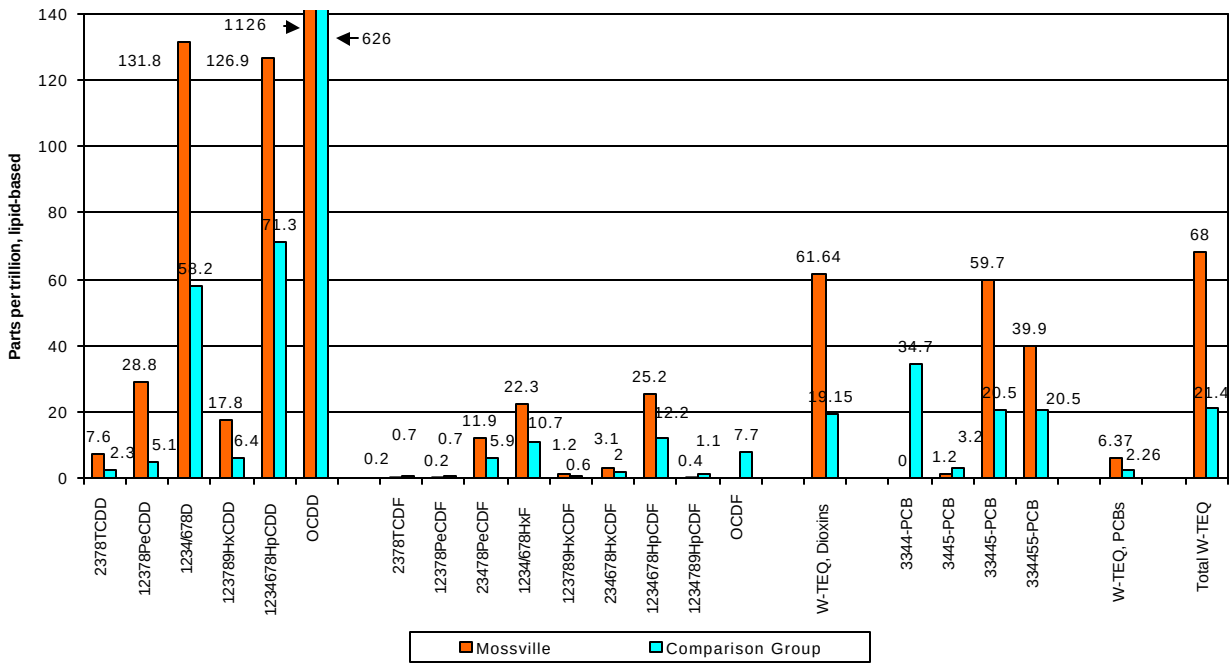


Figure 2: `Profile' of Average Concentrations of Dioxins and Dioxin-Like PCBs in Blood Lipids of Mossville Residents and ATSDR Comparison Group



ATSDR's medical consultant concluded that the unique profile of the dioxins and dioxin-like PCBs found in the blood of the Mossville residents suggests that one or more local sources are contributing to the elevated levels of these chemicals found in these people.[8] Statistical analysis of the I-TEQ from dioxins and that from the four PCBs shows that the concentrations of these two groups of chemicals vary independently. I.e., high levels of dioxins are not associated with high levels of PCBs. This suggests that the local sources of dioxins may be different from local PCB sources.

Dioxins and PCBs in Breast Milk

One sample of breast milk from a Mossville woman was also analyzed and found to carry a total concentration of dioxins and the four dioxin-like PCBs of 13.5 ppt I-TEQ, lipid-based. Based on the analytical data later provided by ATSDR, this total consisted of some 11.9 ppt I-TEQ from dioxins and about 1.5 ppt I-TEQ from the PCBs. No information was provided on those factors that are known to influence contaminant levels in breast milk, e.g., the woman's age, duration of lactation, number of children, and length of residency in a contaminated area, such as Mossville.

ATSDR noted that the dioxin concentration in this woman's breast milk was below the 16 ppt I-TEQ[d] found in a study of 42 U.S. women by Schecter et al. (1992).[9] However, a more valid comparison is with the 9 ppt I-TEQ reported by Schecter et al. (1997) in U.S. breast milk samples taken during 1995-1997.[10] (The reduction in dioxin levels in U.S. breast milk evident

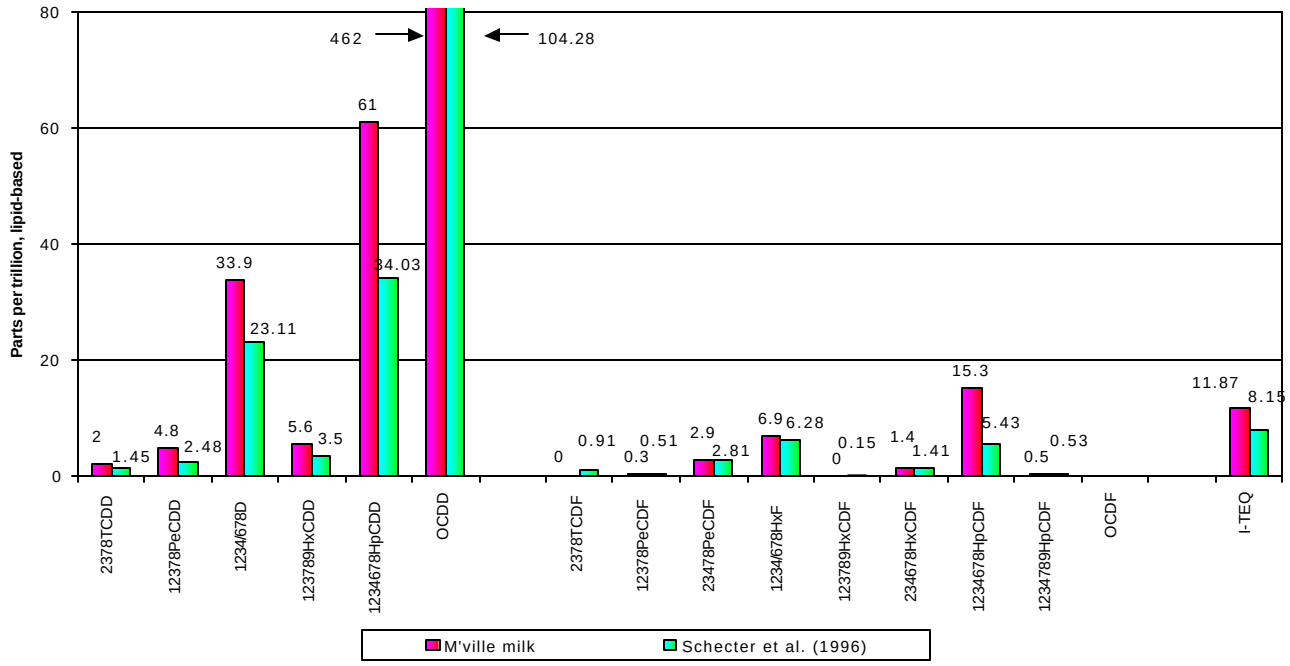
[d] ATSDR failed to note that the study by Schecter et al. (1992) addressed only dioxins and did not include the contribution of dioxin-like PCBs.

since the earlier study is in agreement with similar trends reported in other industrialized countries.[11])

Table 1: Dioxins and PCBs in Breast Milk					
Sample	Year of samples	Number of samples	I-TEQ, ppt (lipid-based)		
			Dioxins	PCBs	Total
Mossville breast milk	1998	1	11.9[e]	1.5	13.5
U.S. breast milk[12]	1995-97	22	9	na	--
U.S. breast milk[13]	1992	42	16	na	--
Breast milk, Binghamton, NY[14]	1995-96	4	8.16	2.02	10.17
Netherlands, limit for cow's milk[15]			6		

na: no analysis performed

Figure 3: Mossville, Louisiana: Dioxin Concentrations in One Breast Milk Sample from Mossville and Concentrations Reported by Schecter et al. (1996).



[e] Based on the analytical data provided by ATSDR, the Mossville breast milk sample contained no detectable levels of 2,3,7,8-tetrachlorodibenzofuran and 1,2,3,7,8,9-hexachlorodibenzofuran. Also octachlorodibenzofuran was not reported. Contrary to the conventional procedure of using one-half the detection limit as the estimated concentration of congeners that are below the detection limit, ATSDR assigned a value of zero for these three congeners. Consequently, the resulting values for dioxin TEQs and total TEQs in the Mossville breast milk sample are lower than the values that would have been obtained had the conventional procedure been followed.

As shown in Table 1, the level of total dioxins in the breast milk sample from Mossville is 1.3 times higher than the most recently reported average level in the breast milk of U.S. women. This finding suggests that infants born in Mossville may be experiencing higher prenatal and postnatal dioxin exposure than the average U.S. infant. This `background' exposure may itself be sufficient to impact the developing fetus and nursing infant, as described recently by Weisglas-Kuperus (1998):[16]

> *"PCBs and dioxins are present in background exposed mothers and their infants at concentrations that might be toxicologically relevant. These chemicals may interfere with endogenously produced hormones."*

Indeed the impacts of perinatal exposure at background levels have been documented in three recent studies:

- Scientists in Japan reported in one study that *"our study suggests that exposure to background levels of the highly toxic organochlorine compounds [dioxins] through the breast milk influences the human neonatal immune system."* [17]

- In a second study, scientists report that *"exposure to background levels of the highly toxic organochlorine chemicals through the breast milk may cause some effects on thyroid hormone status…"*[18]

- In a study of the teeth of breastfed children, Finnish scientists found, *"Defects were clearly associated with the total exposure to toxic dioxins and furan."* Noting that the *"high frequency of hypomineralised dental defects among normal children may be a sign of exposure to PCDD/Fs [dioxins],"* they proposed that such defects *"may be the best available indicator of dioxin exposure."*[19]

Consequently, the children who are or have been conceived, gestated and/or born in Mossville may suffer the consequences of extraordinary exposure to dioxins and dioxin-like contaminants:[20]

> *"… [P]renatal dioxin/PCB exposure can cause growth deficits, motor dysfunction, neurodevelopmental disabilities, learning problems and hearing disorders in humans. …, neurotransmitters and growth factors and may change the course of prenatal human development. Cognitive and neuromotor changes, differences in immune response, reduced birthweight, microgenitalism, reduced fertility and change in the male/female ratio may all be associated with human prenatal PCB/dioxin exposure."*

ATSDR medical consultants have recommended the investigation of these potential impacts on Mossville children:[21]

> *"A review of school records and possibly additional educational testing may be useful in identifying the effects of chemical exposure in Mossville. This testing, in and of itself, would permit more accurate identification of learning disabilities among the children in the area and lead to an understanding of the educational resources needed to redress these problems."*

Contrary to ATSDR's conclusion, the level of dioxins and dioxin-like chemicals in the Mossville mother's milk is elevated and, further, it is a health concern. As shown in Table 1, both the breast milk of the Mossville mother and the breast milk of the average nursing mother in the U.S.

carry dioxins at levels that exceed the concentration at which the government of the Netherlands deems cow's milk to be too contaminated for commercial sale. [22]

Dioxins and PCBs in Eggs

The concentrations of dioxins were measured in two chicken eggs from yard chickens raised in Mossville and one egg from a Kansas City supermarket, as shown in the table below. Based on the analytical data provided by ATSDR, the concentrations of PCBs or other dioxin-like chemicals were not determined in the eggs.

Table 2: Dioxins and PCBs in Eggs			
Sample	I-TEQ, ppt (lipid-based)		
	Dioxins	PCBs	Total
Mossville egg 1	2.09	na	--
Mossville egg 2	1.60	na	--
Kansas City egg	0.951	na	--
Home-produced eggs, Nevada County, California[23]	0.15	na	--
FDA threshold for declaring eggs to be `adulterated" [24]	1		

na: no analysis performed.

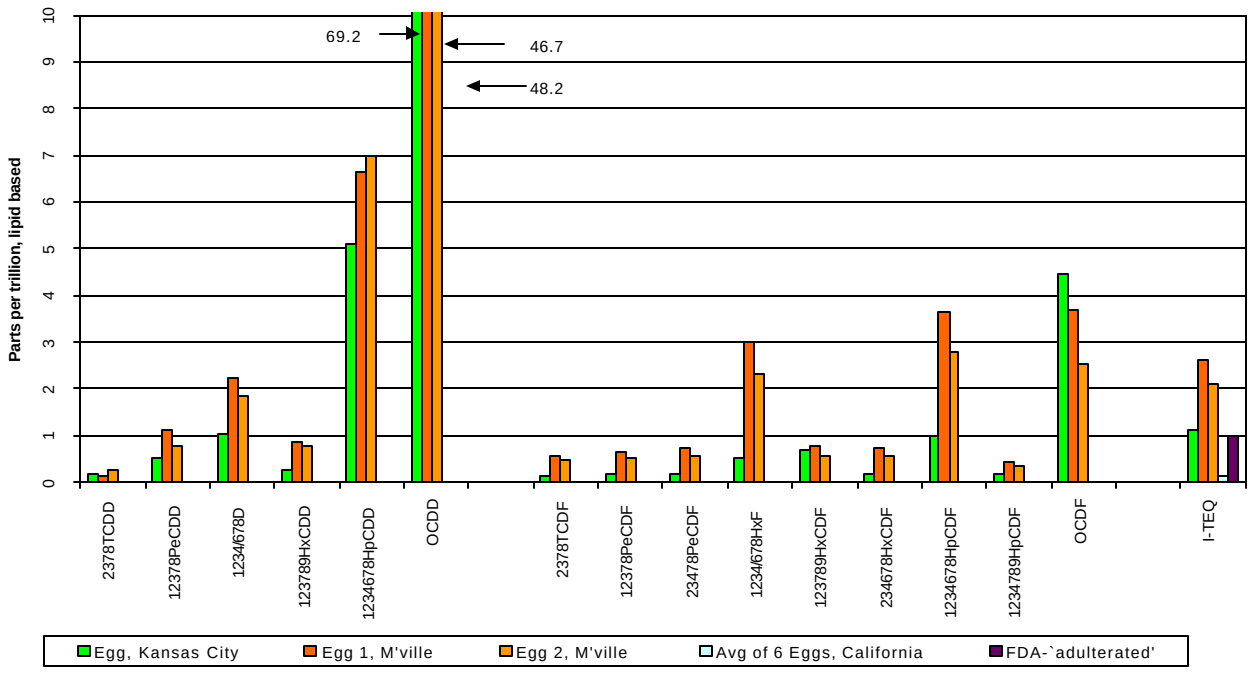
ATSDR noted, *"The dioxin levels detected in Mossville eggs were less than those detected in eggs from chickens that were allowed to forage outside in uncontaminated areas."*[25] However, the study cited by ATSDR in support of this finding was carried out in Switzerland.[26] In contrast, dioxin concentrations in the Mossville eggs ranged from 10-14 times higher than those found in home-produced eggs in an uncontaminated area in California.[27]

It is also important to note that dioxin levels in the Mossville eggs were approximately two times higher than the level at which the Food and Drug Administration (FDA) classifies eggs as adulterated.[28] In comparison, the dioxin concentration in the egg from a Kansas City supermarket was about one-half of that in the Mossville eggs and slightly below the FDA threshold.

No data were collected on levels of dioxins and dioxin-like chemicals in the flesh of yard chickens in Mossville. However, in a recent study in California, chickens that foraged on soils with dioxin levels of 34-40 ppt I-TEQ produced eggs that had an average dioxin content of 10 ppt I-TEQ, while dioxin concentrations of 177-228 ppt I-TEQ were measured in the fat of these chickens. The people who consumed these eggs and chickens were found to have elevated dioxin levels in their blood. [29]

In other words, contrary to ATSDR's conclusion, the dioxin levels found in home-produced eggs in Mossville are clearly a public health concern.

Figure 4: Dioxin Levels in Home-Produced Eggs from Mossville, a Commercial Egg from Kansas City, and the Average of Six Home-Produced Eggs from an Uncontaminated California Site



Dioxins and PCBs in Soil

Dioxin concentrations, in I-TEQ, were determined in three soil samples taken from *"three residential yards located across the street from a VCM plant"* and one soil sample from a chicken coop at one of these homes. Based on data provided by ATSDR, the concentrations in the soils of other dioxin-like chemicals, such as PCBs, were not determined.

ATSDR characterized the dioxin levels found in the Mossville yards as follows:

> *"ATSDR set an Action Level of 1 ppb for dioxin contamination in residential soil [21]. The levels of dioxin contamination detected in surface soil from three Mossville yards were 36 to 250 times less than the ATSDR Action Level and do not pose a health hazard."*

First, it is important to note that the Action Level established by ATSDR is not limited to dioxins alone but includes dioxins and dioxin-like compounds such as certain PCBs as well as other chemicals that have dioxin-like activity. [30] Since ATSDR did not determine the concentrations of PCBs and other dioxin-like chemicals in Mossville soils, there is no basis for determining

whether the soils meet either ATSDR's Action Level of 1 ppb or the emergency media evaluation (EMEG)[f] level of 50 ppt.

Table 3: Dioxins and PCBs in Soil			
	I-TEQ, ppt (dry weight)		
	Dioxins	PCBs	Total
Sample			
Yard soil 1	4	na	--
Yard soil 2	19	na	--
Yard soil 3	28	na	--
Chicken coop soil[g]	0.6	na	--
Rural soil, U.S. [31]	< 1		
Urban/suburban soil, U.S. [32]	11		
U.S. soil, average [33]	8		

na: no analyses performed

It is also important to note that, in setting the Action Level of 1 ppb and the EMEG of 50 ppt, ATSDR considered only a few selected routes of exposure, such as soil ingestion, dermal absorption through soil exposure, and inhalation.[34] ATSDR did not consider indirect routes of exposure that are of particular importance in Mossville, e.g., uptake by foraging chickens and other domestic animals and wildlife with subsequent ingestion by residents; uptake from soil by vegetation that serves as a food source for residents; and volatilization from soil and adsorption by vegetation used as a food source by residents. For example, in their study of the uptake by chickens of dioxins in contaminated soil, Stephens et al. (1995) concluded as follows:[35]

> *"Results from this study indicate that animals foraging on soil contaminated at low ppt PCDD/PCDF levels may bioaccumulate these compounds to unacceptable levels."*

In their recently published study, Goldman et al. (2000) confirmed a dose-response relationship between the consumption of home-produced eggs and meat and dioxin levels in people. They found elevated dioxin levels among people who consumed eggs from chickens in an area where soil dioxin levels were 34-40 ppt I-TEQ. Their conclusion gives even further emphasis to the issue of the soil-food exposure route in Mossville as follows:[36]

> *"Current guidelines for [dioxins] in residential soil in the United States use 1 ppb as an action level to protect children while playing in soil. Estimates of soil concentrations at the*

[f] ATSDR's EMEG of 50 ppt is the comparison value used by ATSDR health assessors to select contaminants for further evaluation based on concerns about end points other than cancer. In general, if a concentration of a chemical at a site is less than the EMEG, ATSDR assumes there is little likelihood that the chemical presents a health hazard at the site via a particular environmental medium. In some instances, ATSDR may consider contaminants present at levels below the EMEG, based on community health concerns. A full range of strategies to interdict exposures and reduce overall body burdens are considered. These exposure interdiction strategies include restricted land use and access, health education, relocation, and remediation to reduce incremental contributions to body burdens and risks of potential health effects. [De Rosa, C., Brown, D., Dhara, R., Garrett, W., Hansen, H., Holler, J., Jones, D., Jordan-Izaguirre, D., O'Connor, R., Pohl, H., Xintaras, C. 1997. Dioxin and dioxin-like compounds in soil, Part II: Technical support document for ATSDR interim policy guideline. J. Clean Technol., Environ. Toxicol., & Occup. Med. 6: 127-138.]

[g] As noted by ATSDR, the owner of the chicken coop reported having *"placed clean sand over the dirt floor of the coop.'*

index homes suggest that low parts-per-trillion levels are of concern for dietary exposure pathways. … To protect against animal product contamination and subsequent indirect dioxin exposure, it may be necessary to substantially reduce this soil cleanup level. … Environmental and biologic half-lives, each of which may be measured in decades, strongly indicate that indirect dioxin exposure is a long-term problem."

Contrary to ATSDR's conclusion, the levels of dioxins in Mossville soils clearly are elevated and are a public health concern.

Potential Sources of Dioxin Contamination in Mossville

Industrial activities in the vicinity of Mossville were described by ATSDR as follows:

"Calcasieu Parish contains a large number of chemical manufacturing plants that produce chemicals such as chlorinated hydrocarbon solvents, vinyl chloride monomer, and petroleum-based chemicals."

ATSDR also listed some specific activities that are carried out near Mossville that have been identified by the U.S. Environmental Protection Agency as known dioxin sources:

- Hazardous waste incinerators*: "Chemical wastes from some of these operations are burned in hazardous waste incinerators operated by industries in the area. … The incineration of chlorinated hydrocarbon wastes can also produce CDDs and CDFs."* ATSDR also specifically noted, *"The [VCM] plant [across the road from Mossville] also has two incinerators for chlorinated compounds that burn only gaseous vents from the VCM unit process. These incinerators have been sampled according to EPA methods and reportedly emit less than 0.1 grams of total dioxin per year."* ATSDR cited no source for the estimated dioxin releases to air from the incinerators at this facility. However, on request, the Agency provided a document described as the source of this information, an undated fact sheet from CONDEA Vista, the VCM facility across the road from Mossville.[37]

- Vinyl chloride monomer production*: "Small amounts of CDDs and CDFs are reportedly formed during the production of vinyl chloride monomer."* It should be noted that the report cited by ATSDR as the source of this information makes no mention of the quantities of dioxins produced during vinyl chloride monomer (VCM) production. This report, which was prepared by the U.S. Environmental Protection Agency, notes that industry and Greenpeace agree that dioxins are generated during VCM production but do not agree about the fraction of such dioxins that are released to the environment.[38] Indeed, the production of VCM is accompanied by the generation of relatively large quantities of dioxins and PCBs.[39]

- Regeneration of petroleum refining catalysts: *"The regeneration of catalysts used in petroleum refining is another potential source of CDDs and CDFs."*

- Flares that burn chlorine-containing materials*:* ATSDR reported, *"Several flares at this [VCM] facility [across the road from Mossville] intermittently burn unidentified materials. A representative of the plant reported that the flares do not burn chlorinated hydrocarbons or other materials that contain chlorine."*

The dioxin sources in the Mossville vicinity that have already been identified by ATSDR must, of course, be thoroughly characterized and monitored with the aim of their elimination. In addition, however, all remaining sources of dioxins and dioxin-like chemicals, including reservoir sources such as soils and sediments, must be identified, characterized and monitored with the aim of their elimination.

Recommendations

ATSDR presented the following recommendations:

(1) "Evaluate potential pathways for human exposure from environmental and dietary sources."

(2) "Reduce human exposures to dioxin from significant exposure pathways that are identified."

(3) "Further characterize the extent of dioxin exposure in the community."

(4) "Evaluate strategies to assess past exposures to dioxin."

(5) *"Examine health status indicators for the community including cancer incidence statistics."*

The most striking aspect of ATSDR's conclusions is the absence of a recommendation to identify and eliminate local sources of dioxins and dioxin-like chemicals such as PCBs. However, in responses to comments on the preliminary EI report, the Agency partially acknowledged the necessity of such actions, even describing one specific strategy: [40]

> *"Therefore, it is prudent public health policy to identify sources of excess dioxin exposure and reduce exposure from those sources. … Air sampling for dioxin would provide the most direct and unequivocal evidence to address the question of whether there is a current airborne source of dioxins in the community."*

ATSDR's medical consultants made further recommendations as follows:

(1) "There is an urgent need for real time regular monitoring of the chemical releases from the plants. This monitoring should attempt to identify the sources of the chemicals revealed in the blood testing as well as other toxins potentially released".

(2) "Additional individual medical testing for the presence of toxins in large segments of the community, without further characterization of the environmental exposures, would be an unproductive exercise. However, some additional blood work may be needed in conjunction with efforts to characterize the exposures and their effects. These tests should be limited to identifying health effects needed to correlate with documented exposures e.g. if dioxin levels are found to be significantly higher in one set of homes, it might be necessary to perform additional medical testing on the residents of those homes. The tests should not be done simply to document levels of exposure throughout the community."

(3) *"As an initial attempt to identify community wide health effects of exposure, a review should be conducted, in conjunction with the Louisiana Tumor Registry at Louisiana State University Medical Center, of the community's cancer data on a census tract or zip code basis."*

(4) "Finally, while no children were among either the 28 who initially had blood tests conducted nor were there any children evaluated by Dr. Orris, there were a number of concerns raised by residents at all the meetings about the possible effects of exposure on the children in

the community. Studies have shown that several of the chemicals in this group may preferentially affect the developing brain of a fetus during pregnancy."[41,42]

In general, Greenpeace supports these recommendations by ATSDR and its medical consultants with the added proviso that the contaminants of concern must include not only dioxins but also PCBs and other dioxin-like chemicals. Further, Greenpeace urges ATSDR, the U.S. Environmental Protection Agency (USEPA), the Louisiana Department of Environmental Quality (LDEQ) and other relevant entities to take the following actions as expeditiously as possible through the Mossville Environmental Justice Workgroup coordinated by ATSDR, or as a separate initiative via a special collaborative emergency effort by USEPA, ATSDR, LDEQ and other agencies in consultation with residents of the Mossville community and Mossville Environmental Action Now:

- Identify and eliminate the local sources of the dioxins and dioxin-like contaminants that are found in the blood and breast milk of Mossville residents, the soils of their homes and their food sources.
- As the sources of dioxins and dioxin-like chemicals are identified and eliminated, take all appropriate actions to reduce exposures from any remaining reservoir sources such as soils and sediments.
- Appropriate actions include remediation of such reservoir sources to protect and preserve the rights of Mossville residents to maintain their chosen levels of food self-sufficiency through gardening, animal husbandry, hunting and fishing without the threat of dioxins, dioxin-like chemicals and related toxic contaminants.
- Relocate all residents who so desire to an area where significant threats of contamination by dioxins, dioxin-like chemicals and other toxic contaminants do not exist.
- Issue a moratorium on any new permits for activities or enterprises that release dioxins, dioxin-like chemicals and other toxic contaminants into the environment in or near Mossville.
- The elimination of sources of dioxins and dioxin-like chemicals will have both positive and negative economic impacts in the communities where sources such as manufacturing and disposal facilities are located. To mitigate potentially negative economic impacts, transition planning processes must be an integral component of any dioxin elimination strategy.

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